United States Department of the Interior

U.S. GEOLOGICAL SURVEY
DOI Southeast Climate Science Center
Dept. of Biology, 127 David Clark Labs
North Carolina State University
Raleigh, North Carolina 27695-7617

NC STATE UNIVERSITY

SECSC FY12 Science Funding and Project Summaries FY09-FY12

Fiscal Year 2012 - New projects

Synthesis of climate model downscaling products for the southeastern United States
Ryan P. Boyles, NCSU; FY12 Funding: $45,000, Completion: September 2013 (ryan_boyles@ncsu.edu)

Hydrological modeling for flow-ecology science in the Southeastern United States
Jonathan Kennen, USGS New Jersey Water Science Center**;** FY12 Funding: $45,000**,** Completion: July 2013 (jgkennen@usgs.gov)

A Handbook for Resource Managers to Understand and Utilize Sea-Level Rise and Coastal Wetland Models for Ecosystem Management under Future Conditions
Thomas W. Doyle, USGS National Wetlands Research Center; FY12 Funding: $45,000, Completion: June 2013 (doylet@usgs.gov)

Assessing climate-sensitive ecosystems in the Southeastern United States
Jaime Collazo, USGS NC Cooperative Fish and Wildlife and William J. Wolfe, USGS Tennessee Water Science Center; FY12 Funding: $100,000, Completion: September 2013 (jaime_collazo@ncsu.edu; wjwolfe@usgs.gov)

Communicating and Using Uncertain Scientific Information in the Production of 'Actionable Science'
Dr. Brian Irwin, USGS Georgia Cooperative Fish and Wildlife Research Unit; FY12 Funding: $39,926, Completion: June 2013 (bjirwin@usgs.gov)

Connectivity for Climate Change in the Southeastern United States
Dr. Nick, Haddad, NCSU; FY12 Funding: $150,000, with anticipated funding level in FY13 of $150,000, Completion: September 2014 (nick_haddad@ncsu.edu)

Ecological implications of mangrove forest migration in the Southeastern United States
Michael Osland, USGS National Wetlands Research Center; FY12 Funding: $124,284, with anticipated funding level in FY13 of $147,792, Completion: September 2014 (mosland@usgs.gov)

Developing long-term urbanization scenarios for the Caribbean LCC as part of the Southeast Regional Assessment Project
Jaime Collazo, USGS North Carolina Cooperative Fish and Wildlife Research Unit; FY12 Funding: $39,000, Completion: January 2014 (jaime_collazo@ncsu.edu)

Assessment of terrestrial and aquatic monitoring programs in the Southeastern United States
Damian Shea and Cari Furiness, NCSU; FY12 Funding: $24,794, Completion: September 2013 (d_shea@ncsu.edu)

Fiscal Year 12 – Carry-over Projects

Integrating the Effects of Global and Local Climate Change on Wildlife in North America
Rob Dunn (NCSU, Biology), Steve Frank (NCSU, Entomology), Nick Haddad (NCSU, Biology), Nadia Singh (NCSU, Genetics), and other researchers; FY12 Funding: $85,000, Completion: July 2014

Predicting vulnerability of Southeastern sea turtle nesting beaches to climate change
Kristen M. Hart, USGS Southeast Ecological Science Center; FY12 Funding: $150,000, Completion: September 2012.

Impact of Ocean Warming and Acidification on Growth of Reef-building Corals
Ilsa B. Kuffner, USGS St. Petersburg Coastal and Marine Geology Science Center; FY12 Funding: $150,000, Completion Date: January 2013

Developing long-term urbanization scenarios for the Appalachian and Gulf Coastal Plain and Ozarks LCCs as part of the Southeast Regional Assessment Project
Jaime Collazo, USGS North Carolina Cooperative Fish and Wildlife Research Unit; FY12 Funding: $45,500, Completion: January 2013

Southeast Regional Assessment Project (SERAP)
Brian Hughes, Georgia Water Science Center and various investigators; FY12 Funding: $153,500, Completion: September 2014.

SECSC Project Summaries - Fiscal Year 2012

Synthesis of climate model downscaling products for the southeastern United States

Ryan P. Boyles, Ph.D., NCSU

Funding: Total funding for this project is $45,000

Project Completion: September 2013

Overview: Downscaling translates large-scale climate information to the local scale. There are several techniques for handling this process; recently, several downscaled climate products have been produced by government and academic researchers. Ecologists, conservation scientists, and practitioners require such local guidance to evaluate adaptation and conservation strategies. However, the large number of methods involved, different downscaling approaches, resolutions, time periods, and focal variables limits the ability of these users to form meaningful conclusions and evaluate the results of adaptation strategies. To address these issues, this project will summarize the methods used for downscaling, identify the metrics most appropriate for evaluation of climate model skill and usability for the ecological and conservation communities in the southeastern US, and begin a longer-term effort to evaluate the range of downscaled climate products over this geographic region. To accomplish this, we propose a comprehensive literature review on the methods used to develop these data, engagement with the LCC, USGS scientific, and practitioner community to identify climate metrics and variables needed, and initial evaluation of several downscaled climate data products. This project will serve as input for other efforts by USGS and LCC scientists to compare various climate guidance products.

Hydrological modeling for flow-ecology science in the Southeastern United States

Jonathan Kennen, Ph.D., USGS, New Jersey Water Science Center

Funding: Total funding for this project is $45,000

Project Completion: July 2013

Overview: Stream flows are essential for maintaining healthy aquatic ecosystems and for supporting human water supply needs. Integrated modeling approaches assessing the impact of changes in climate, land use, and water withdrawals on stream flows and the subsequent impact of changes in flow regime on aquatic biota at multiple spatial scales are necessary to insure an adequate supply of water for humans and healthy river ecosystems. The combined application of simple, large scale models with more complex, high resolution models has the potential to provide for more robust climate change impact studies, which focus on maintaining a better balance between the availability of water to support aquatic assemblages while conserving water for long-term human needs than using either approach in isolation. The objective of this proposal is to 1) inventory existing hydrologic modeling efforts in the Southeast region; 2) evaluate and compare performance of participating hydrologic models in predicting observed stream flows; 3) demonstrate the feasibility of using regional and local scale models to identify unique areas of concern and understand fine scale hydrologic dynamics for climate change assessment, respectively; and 4) synthesize the work on developing flow-ecology relationships in the region.

A Handbook for Resource Managers to Understand and Utilize Sea-Level Rise and Coastal Wetland Models for Ecosystem Management under Future Conditions

Thomas W. Doyle, USGS National Wetlands Research Center

Funding: Total funding for this project is $45,000

Project Completion: June 2013

Overview: A handbook will be constructed from training and feedback sessions with FWS resource staff and other coastal managers (NOAA, NPS) of published decision-support tools and simulation models for sea-level rise and climate change assessments. Various sea-level rise and coastal wetland models have been developed and applied using different designs and scales of spatial and temporal complexity for predicting habitat and

environmental change that have not heretofore been synthesized to aid natural resource managers of their utility and limitations. Some are more accessible as online tools while others require more expert capacity to parameterize and run for any given park, refuge, reserve, or regional application. Training sessions will be conducted with Federal land managers from FWS, NPS, and NOAA across the pan-Gulf and South Atlantic states of the southeastern U.S. to educate and evaluate user needs and understanding of concepts, data, and modeling tools for projecting sea-level rise and its impact on coastal habitats and wildlife. A simplified tabular context will be developed by list of decision-support tools, ecological models, and criteria to distinguish the source, scale, and quality of input information and geographic data sets, physical and biological constraints and relationships, datum characteristics of water and land elevation components, utility options for setting sea-level rise and climate change scenarios, and ease or difficulty of storing, displaying, or interpreting model output. The handbook will provide a layman's guide to understanding climate change based on a practical synthesis of the current state of knowledge and tools suitable for DOI land management need and facilitating Landscape Conservation Cooperative (LCC) science and conservations initiatives.

Assessing climate-sensitive ecosystems in the southeastern United States

Dr. Jaime Collazo, USGS NC Cooperative Fish and Wildlife and Dr. William J. Wolfe, USGS Tennessee Water Science Center

Funding: Total funding for this project is $100,000
Project Completion: September 2013

Overview: The southeastern U.S. contains a unique diversity of ecosystems that provide important benefits, including habitat for wildlife and plants, water quality, and recreation opportunities. As climate changes, a better understanding of how our ecosystems will be affected is vital for identifying strategies to protect these ecosystems. While information on climate change affects exists for some ecosystems and some places, a synthesis of this information for key ecosystems across the entire Southeast will enable regional decision-makers, including the LCCs, to prioritize current efforts and plan future research and monitoring. This study will develop a regional synthesis of the types, geographic distribution and controls, scientific understanding, and conservation status of spatially discrete endemic or disjunct ecosystems whose hydrology, soils, or physiography make them especially sensitive to shifts in regional precipitation or temperature throughout the Southeast and the Caribbean. We will synthesize existing information on current threats, climate change impacts, and the capacity of these ecosystems to adapt to climate change. We will combine data from ecological and geographic databases, scientific literature, technical reports, and expert knowledge to assess climate affects. Throughout the project, we will work with LCCs and other experts to supplement our analysis and ensure that our work is useful for informing conservation. The result of our research will be a list of key conservation strategies that will help ecosystems adapt to climate change.

Communicating and Using Uncertain Scientific Information in the Production of 'Actionable Science'

Dr. Brian Irwin, USGS Georgia Cooperative Fish and Wildlife Research Unit

Funding: Total funding for this project is $39,926
Project Completion: June 2013

Overview: Conservation practitioners must navigate many challenges to advance effective natural-resource management in the presence of multiple uncertainties. Numerous climatic and ecological changes remain on the horizon, and their eventual consequences are not completely understood. Even so, their influences are expected to impact important resources and the people that depend on them across local, regional, and sometimes global scales. Although forecasts of future conditions are almost always imperfect, decision makers are increasingly expected to communicate and use uncertain information when making policy choices that affect multiple user groups. The degree to which management objectives are met can depend on 1) how critical uncertainties are identified and accounted for, and 2) effective communication among user groups, scientists, and resource

managers. The objective of this project is to help facilitate strategic decision support and synthesize the state of the science related to communicating and using uncertain information in conservation decision making. By providing a forum on the communication of scientific uncertainty, we aim to traverse traditional disciplinary boundaries, with a focus on climate change in the southeastern United States. We expect this process to generate transferable guidance that will directly assist resource managers across agencies to identify common goals and shared research priorities.

Connectivity for Climate Change in the Southeastern United States

Dr. Nick, Haddad, NCSU

Funding: Total funding for this project is $300,000. Funding levels in FY12 are $150,000, while anticipated funding levels in FY13 are $150,000.

Project Completion: September 2014

Overview: Climate change is already affecting biodiversity, changing the dates when birds arrive to breed and when flowers bloom in spring, and shifting the ranges of species as they move to cooler places. One problem for wildlife as their ranges shift is that their path is often impeded – their habitats have become fragmented by agriculture and urbanization, presenting barriers to their migration. Because of this, the most common recommended strategy to protect wildlife as climate changes is to connect their habitats, providing them safe passage. There are great challenges to implementing this strategy in the southeastern U.S., however, because most intervening lands between habitat patches are held in private ownership. We will combine data on key wildlife species and their habitats throughout the southeastern U.S. with new computer modeling technologies that allow us to identify key connections that will be robust to regional and global changes in climate and land use. Our proposed work will engage LCCs and other stakeholders in identifying focal species and key connections, and in designing and then implementing a connectivity plan. Our effort will provide a template for how to reconnect landscapes in the southeastern U.S. to permit wildlife to adapt to a changing climate.

Ecological implications of mangrove forest migration in the southeastern United States

Michael Osland, USGS National Wetlands Research Center

Funding: Total funding for this project is $272,076. Funding levels in FY12 are $124,284, while anticipated funding levels in FY13 are $147,792.

Project Completion: September 2014

Overview: Winter climate change has the potential to have a large impact on coastal wetlands in the southeastern U.S. Warmer winter temperatures and reductions in the intensity of freeze events would likely lead to mangrove forest range expansion and salt marsh displacement in parts of the U.S. Gulf of Mexico and Atlantic coast. The objective of the proposed research is to better evaluate the ecological implications of mangrove forest migration and salt marsh displacement. The potential ecological impacts of mangrove migration are diverse ranging from important biotic impacts (e.g., coastal fisheries, land bird migration; colonial nesting wading birds) to ecosystem stability (e.g., response to sea level rise and drought; habitat loss; coastal protection) to biogeochemical processes (e.g., carbon storage; water quality). The proposed research will investigate the impact of mangrove forest migration on coastal wetland soil processes and the consequent implications for coastal wetland responses to sea level rise and carbon storage.

Developing long-term urbanization scenarios for the Caribbean LCC as part of the Southeast Regional Assessment Project

Jaime Collazo, USGS North Carolina Cooperative Fish and Wildlife Research Unit

Funding: Total funding for this project in FY12 is $39,000

Project Completion: January 2014

Overview: This project extends the long-term urbanization modeling already undertaken for the South Atlantic, Gulf Coastal Plains and Ozarks, and Appalachian LCCs as part of SERAP into the Caribbean LCC.

Assessment of terrestrial and aquatic monitoring programs in the Southeastern United States

Damian Shea and Cari Furiness

Funding: Total funding for this project is $19,794.

Project Completion: September 2013

Overview: A significant challenge faced by climate scientists in the public and private sector is the need for information about the historical status of ecological systems expected to be influenced by climate change. The need is especially acute for reliable and complete information about monitoring networks maintained by government and non-governmental organizations and associated data. While many organizations monitor one or more aspects of aquatic and terrestrial ecosystems, these monitoring programs are seldom coordinated and information about both the networks and the associated data are not readily available. The DOI Southeast Climate Science Center is participating in an effort by multiple federal, state, and other organizations to develop a comprehensive and integrated assessment of monitoring networks associated with atmospheric, stream, and terrestrial ecosystems. The objective of this two-year project is to support the development of this assessment. Tasks will include: compile, inventory, and map geographically, sources (federal, state, local and non-governmental) of atmospheric, terrestrial, water quality and quantity information, and analysis capacity in the region to address climate issues; characterize the sources of information in terms of longevity and "depth", consistency over time, and types and quality of information; assess other attributes of the information sources to be identified; assess currently available information for use in tracking regional trends, or running scenarios of interest to federal, state and local resource managers; and, identify key information gaps of concern to federal, state and local resource managers. The geographic scope of this effort will include the states of North Carolina, Tennessee, Mississippi, Alabama, Georgia, and Florida and the Commonwealth of Puerto Rico. Results from this proposed work will provide the region's scientists and decision makers with accurate and comprehensive information about monitoring networks that can be used to assess the potential effects of climate change in the southeastern United States.

SECSC Project Summaries - Fiscal Year 2011

Integrating the Effects of Global and Local Climate Change on Wildlife in North America

Rob Dunn (NCSU, Biology), Steve Frank (NCSU, Entomology), Nick Haddad (NCSU, Biology), Nadia Singh (NCSU, Genetics), and other researchers

Funding: Total funding for this project is $150,000.
Project Completion: July 2014

Overview: Climate in the southeastern U.S. is predicted to be changing at a slower rate than other parts of North America; however, land use change associated with urbanization is having a significant effect on wildlife populations and habitat availability. Little is known about the effect of urbanization on future projections of climate change; the objective of this project is to determine the effect of urbanization on future climate projections and how those projections, including urbanization, affect wildlife habitat and populations in the Southeast.

Deliverables: This project is a two-year project that builds upon research already being conducted at NCSU and partner universities and research organizations. Key products will include:

1. North American maps of current ground temperatures and maps and models of future ground temperatures due to urbanization (in collaboration with NASA and University of Maryland)
2. Incorporation of urbanization models into regional climate change models
3. Maps of species (various) distribution through time
4. A predictive model of future species (various) distribution with increased urbanization and changing climate
5. Google Earth application that will allow the general public to view the potential consequences of climate change on the landscape (in conjunction with NC Museum of Natural Sciences and linked to globalchangeforum.com)
6. Publication of three peer-reviewed journal articles

Predicting vulnerability of Southeastern sea turtle nesting beaches to climate change

Kristen M. Hart, Ph.D., Research Ecologist, USGS Southeast Ecological Science Center

Funding: Total funding for this project is $300,000. Funding levels in FY11 are $150,000, while funding levels in FY12 are $150,000.
Project Completion: September 2012

Overview: Sea-level rise (SLR), increased storminess, and altered temperature and humidity associated with climate change may reduce suitability of nesting and foraging habitat used by federally threatened and endangered species, specifically for federally threatened loggerhead sea turtles (*Caretta caretta*). Loggerheads have recently been proposed for upgrading from threatened to endangered status (USFWS & NOAA 2010) due to concerns over declining nest numbers and interactions with longline fisheries. The objective of this project is to produce a vulnerability assessment of coastal habitats representing important nesting grounds specifically for federally threatened loggerhead sea turtles (*Caretta caretta*). Since some of the same nesting beaches are also important for other endangered sea turtles (i.e., Kemp's ridleys (*Lepidochelys kempii)*, green turtles (*Chelonia mydas)*, and leatherbacks (*Dermochelys coriacea)*), this project represents a vulnerability assessment of coastal nesting habitats for multiple species of national conservation significance. Proposed study sites include Cape Romain National Wildlife Refuge, Canaveral National Seashore, Archie Carr National Wildlife Refuge, Everglades National Park, Pine Island National Wildlife Refuge, and Padre Island National Seashore.

Deliverables: This is a two-year project that builds upon work already being done (and subsequent data produced) as part of the La Florida project, as well as work underway as part of the USGS Coastal and Marine

Geology Program's Shoreline and Sea-level rise project and a NASA funded Dune Vulnerability project. Key products will include:

1. Vulnerability maps of sea turtle nesting beaches for the regions modeled
2. Maps of historic and expected changes in occupancy rates for modeled habitats
3. Reports and peer-reviewed publications
4. Maps that describe the present vulnerability under a number of current and future climate scenarios. These maps will provide management guidance now, and serve to help identify where knowledge and data gaps exist that are primary sources of uncertainty.
5. Integrated biological response models which will show nesting site "occupancy" and phenological responses as a function of the beach characteristics likely to be influenced by climate change and SLR.

Impact of Ocean Warming and Acidification on Growth of Reef-building Corals

Ilsa B. Kuffner, Ph.D., Research Ecologist, USGS St. Petersburg Coastal and Marine Geology Science Center

Funding: Total funding for this project is $250,000. Funding levels in FY11 are $100,000, while funding levels in FY12 are $150,000.

Project Completion Date: January 2013

Overview: A retrospective study addressing long-term variability in ocean temperature and pH using coral cores to investigate the response of coral calcification to increasing sea surface temperatures, temperature anomaly events, and decreasing ocean pH that have occurred over the last ~150 years. We will also document present-day variability in temperature and coral calcification rates to record important baseline information as ocean conditions continue to change. This study is the first and only field study of this length and spatial magnitude to obtain valuable coral calcification data directly in the units of g $CaCO_3$ gained per unit time. The results of this study will potentially identify differences in climate vulnerability among three important reef-building coral species, which is very relevant information in making resource management decisions regarding reef restoration and species protection policies. Proposed study sites include Dry Tortugas and Virgin Islands National Parks.

Deliverables: This is a two-year project that will build on the work being done by the USGS Coral Reef Ecosystem Studies (CREST) Project and the USGS Terrestrial, Freshwater, and Marine Ecosystems Program. Peer-reviewed scientific publications will constitute the majority of the expected products from this project. Within 3 years, 2 – 4 peer-reviewed publications will be submitted, with several more in preparation, documenting and interpreting growth rates in three species of reef building corals and relating the observed changes to variations in ocean temperature and pH. The results will be evaluated in the context of model-projected environmental change for the eastern subtropical North Atlantic and Caribbean Sea in the next 30-50 years. This project will also produce a valuable baseline record of calcification rates throughout the Florida Keys.

Developing long-term urbanization scenarios for the Appalachian and Gulf Coastal Plain and Ozarks LCCs as part of the Southeast Regional Assessment Project

Jaime Collazo, USGS North Carolina Cooperative Fish and Wildlife Research Unit

Funding: Total funding for this project is $84,500. Funding levels in FY11 are $39,000, while funding levels in FY12 are $45,500.

Project Completion: January 2013

Overview: Traditional urban growth models are very localized and data-intensive and lack the capability to be applied across large regions, in response to these limitations the North Carolina Cooperative Research Unit began using the USGS SLEUTH urban growth model to develop urbanization scenarios as part of the Southeast Regional Assessment Project (SERAP). This new modeling effort allows LCC's to address fundamental questions that affect conservation planning over decadal time scales. These particular LCCs have experienced both rapid exurban growth (e.g. Atlanta, Houston, Nashville, and Washington D.C.) as well as population decline across Louisiana, Mississippi, West Virginia, eastern Ohio, and central Pennsylvania. Regions of particular interest may include (but are not limited to) simulating population change in the New Orleans-Baton Rouge metropolitan region post-Katrina, urbanization pressures along the Alabama Gulf Coast and Florida panhandle regions, or exurban development pressure on Appalachian habitat corridors in the Washington D.C. metropolitan region. Thus changing urbanization patterns in this region may present special challenges or opportunities for conservation over the coming decades that require additional collaboration in this modeling effort.

Project Goal: Using our modified version of the SLEUTH model, develop baseline and future scenarios of urbanization over the next 50-100 years for the Appalachian and Gulf Coastal Plain and Ozarks Landscape Conservation Cooperatives (LCCs).

Deliverables: This project builds upon work already being done as part of the Southeast Climate Science Center funded Southeast Regional Assessment Project by extending urban growth prediction models to cover the full extent of the Gulf Coastal Plain and Ozarks and Appalachian LCCs.

Southeast Regional Assessment Project (SERAP; funded through the NCCWSC and SECSC)

Funding: Total funding for this project is $2.6M, including $984,000 (FY09), $914,000 (FY10), $636,000 (FY11), and $153,000 (FY12). **Timeline:** The multifaceted nature of this project ensures that each component will have a different timeline, with start and end points intersecting throughout the life of the project. SERAP was initially funded through FY11, although some components of the work are not technically planned for completion until FY13, namely Optimal Conservation Strategies to Cope with Climate Change. Many components of the work plan however are complete and the resulting data sets can be accessed from the GeoData Portal.

Project Team:

Adam Terando	North Carolina State University
Murali Haran	Penn State University
Nathan Urban	Penn State University
Klaus Keller	Penn State University
Katharine Hayhoe	Texas Tech University
Van Wilson	USGS Mississippi Water Science Center
Glenn Guntenspergen	USGS Patuxent Wildlife Research Center
Scott Wilson	USGS National Wetlands Center
Nathaniel Plant	USGS St. Petersburg Coastal and Marine Science Center
Alexa McKerrow	USGS Core Science Systems
Jennifer Costanza	North Carolina State University
Jaime Collazo	USGS North Carolina Cooperative Fish and Wildlife Research Unit
Barry Grand	USGS Alabama Cooperative Fish and Wildlife Research Unit
Max Post Van der Burg	USGS Northern Prairie Wildlife Research Center
Jim Peterson	USGS Oregon Cooperative Fish and Wildlife Research Unit
Lauren Hay	USGS National Research Program
Steve Markstrom	USGS National Research Program
Roland Viger	USGS National Research Program
Nathaniel Booth	USGS Center for Integrated Data Analytics
Robb Jacobson	USGS Columbia Ecological Research Center
Carrie Elliot	USGS Columbia Ecological Research Center
John Jones	USGS Eastern Region Geography
Mary Freeman	USGS Patuxent Wildlife Research Center
Jacob LaFontaine	USGS Georgia Water Science Center
Brian Hughes	USGS Georgia Water Science Center

Overview: SERAP seeks to formally integrate multidisciplinary project components to aid conservation planning and design so that ecosystem management decisions can be optimized for providing desirable outcomes across a range of species and environments. SERAP will provide a suite of regional climate, watershed, and landscape-change analyses and develop the interdisciplinary framework required for the biological planning phases of adaptive management and strategic conservation. There are 4 main SERAP components:

- Developing Regionally Downscaled Probabilistic Climate Change Projections*;*
- Integrated Coastal Assessment*;*
- Integrated Terrestrial Assessment*;* and
- Multi-Resolution Assessment of Potential Climate Change Effects on Biological Resources: Aquatic and Hydrologic Dynamics,

These components produce data and other outputs that are compiled and used in the development of a fifth component:

- Optimal Conservation Strategies to Cope with Climate Change, a tool for resource managers to ensure the most effective land management strategies.

Deliverables: The following sections outline the products that have been or will be produced by the SERAP.

1. *Developing Regionally Downscaled Probabilistic Climate Change Projections* – Statistically downscaled projections of maximum and minimum temperature and mean precipitation through 2099 at 12-kilometer grids for the conterminous U.S.. A select series of derivative data will be produced from model outputs, including, but not limited to potential evapotranspiration, solar radiation, fire frequency, and frost days.

2. *Integrated Coastal Assessment* – Products include predictive maps of shoreline erosion, data collected from 6 sediment elevation table (SET's) sites (24 total installations) located in Mississippi and Alabama, and maps of predicted inundation resulting from sea-level rise (available on the web at *http://gom.usgs.gov/slr/index.html*).

3. *Integrated Terrestrial Assessment* – Products include urban growth projections for 2010 – 2100 at 60-meter grids, vegetation state and transition models at 30 meter grids for each vegetation class in the Southeast with downscaled climate data incorporated as a fire multiplier (A1Fi, B1 scenarios), gridded output of suitable habitat, by species, for 606 terrestrial vertebrates that occur in the Southeast through 2100 for three climate scenarios (A2, A1B and B1) based on non-downscaled climate data, and land-cover maps for 1992, 2001, and 2006.

4. *Multi-Resolution Assessment of Potential Climate Change Effects on Biological Resources: Aquatic and Hydrologic Dynamics* – Products available include predicted streamflow variables, hydrologic cycle components, and simulation of instream temperature fluctuations throughout the Apalachicola-Chattahoochee-Flint (ACF) River basin; as well as updated geomorphic characterization, stream-channel classification, and updated depression storage and vegetation coverages for the ACF River basin. Species-response models will be used to predict the presence or absence of aquatic species in stream segments, for both coarse and fine resolution models, as a result of changing climate conditions

5. *Optimal conservation strategies to cope with climate change* – The final product will be an optimal conservation-strategies model based on identified management and policy alternatives that are most likely to sustain populations of focal species. The model will identify key elements for monitoring to reduce uncertainty regarding the effect of climate change on terrestrial and aquatic populations and their habitats and measure progress toward population and habitat objectives.

All project output will be maintained and readily available on a publically available data portal. The Data Portal was originally conceived as a mechanism to help SERAP team members easily share data and output, but has since been adopted by CSCs nationwide as a preferred data-management tool known as the GeoData Portal.

Summary of projects supported by USGS LCC science funds in SECSC area

Caribbean LCC

Systems' response and adaptation strategies in the Caribbean

Jaime Collazo, USGS North Carolina Cooperative Fish and Wildlife Research Unit, **Funding**: Total funding for this project is $240,000, with all funding coming in FY11. **Project Completion:** The development of tools to simulate climate change effects of water quantity and temperature and the development of vegetation dynamics and land cover projections components of the project will be completed by the end of FY12. Assessing the ecological impacts sea-level rise in Puerto Rico will be completed by the end of FY13.

Overview: The proposed project will extend many of the SERAP components into the Caribbean and facilitate forging long-term partnerships among multiple state and federal agencies, academic institutions and non-governmental organizations in Puerto Rico and elsewhere in the Caribbean, and hence, assist in the efforts to stand-up and operationalize the Caribbean LCC. As part of this project, participants will develop selected, but essential, databases and models to lay the foundation to formulate conservation and adaptation strategies to deal with environmental stressors, particularly climate change. This project facilitates the full integration of science-support projects being conducted in southeastern U.S. aimed at providing managers with a basis to formulate adaptation strategies.

Deliverables: This is a two-year project that will build on work already done as part of the Southeast Regional Assessment Project (SERAP). Key products will include:

1. Models of climate-change related effects on water quantity and water temperature across Puerto Rico
2. Models of vegetation dynamics and projections of future land covers
3. Assessment of the potential impacts of sea level rise on coastal ecosystems and related wildlife resources

Peninsular Florida LCC

Peninsular Florida Landscape Conservation Cooperative (PFLCC) Climate Scenarios and Species Vulnerability Assessment

Dr. Stephanie S. Romañach, Ecologist, USGS, Southeast Ecological Science Center. **Funding:** Total funding for this project is $120,000. Funding levels in FY12 are $120,000. Additionally, there is additional requested funding in FY13 of $120,000. **Project Completion**: September 2013.

Overview: The Peninsular Florida Landscape Conservation Cooperative (PFLCC) is one of the most vulnerable regions to climate change in the U.S. Its low elevation makes it very susceptible to sea level rise and its fragile ecosystems are sensitive to changes in temperature and precipitation. In addition to the threats posed by climate change, the population of the PFLCC is potentially going to double in the next 50 years, requiring as much as 1.7 million acres for urban land use. This demand will create unprecedented landscape changes that will produce significant challenges to ecological systems and human populations. Given the region's complex socioeconomic and ecological dynamics and the large number of governing agencies involved in conservation planning, the key research component is to create an appropriate framework for LCC-scale decision-making across current conservation planning agencies and jurisdictions. The project will develop tools that will provide decision support to the US FWS and the PFLCC stakeholders and steering committee to guide conservation.

Deliverables and Timeline: This is a two-year project that builds on an MIT project "Assessing the challenge of climate change in the greater everglades ecosystem" which developed future regional scenarios for the US FWS and USGS. Key products will include:

- A series of alternative future scenarios that reflect the PFLCC geography
- Geographic data acquisition and processing (new parcels, land values, census 2010, LIDAR terrain, etc.)
- Preliminary integration of ELVeS vegetation succession model outputs
- Public release of PFLCC scenarios and supporting documentation, peer reviewed publications
- Development of preliminary impact assessments together with species experts and external modeling teams
- Development of a comprehensive spatiotemporal vulnerability assessment for the selected representative species
- Development of "Incentives analysis" with report to FWS. What is the potential scope of incentives, including geographies and stakeholder analyses?

Mussel and fish population trends relative to water availability in the Upper Suwanee River Basin, Florida

Noel M. Burkhead and Nathan A. Johnson, U.S. Geological Survey, Southeast Ecological Science Center; Donald DeAngelis, University of Miami, **Funding:** Total funding for this project is $48,000, with all funding received in FY11. **Project Completion**: September 2012

Overview: This project is the inventory phase of a proposed 5-year intensive monitoring study of mussels in the Suwannee River system that will provide data needed to estimate probabilities of population persistence at given river discharges and changes in ground water levels. Each successive year that quantitative monitoring is conducted will increase the statistical power of the model, enabling more robust predictions of abundance and persistence. If the entire 5-year study is completed, refuge managers will be able to ascertain the effects of reduced flows on mussel and host fish populations in the upper basin and will have a vastly increased understanding of how proposed future water withdrawals will affect the biological integrity of the Suwannee River system. The Suwannee River is one of the very few southeastern rivers without a major dam or city located on its mainstem, and it benefits from the Lower Suwannee NWR and five state parks. The basin is home to listed and candidate species of mussels and fishes. Inventory and monitoring research is needed to determine the present community composition of mussels and fishes in order to establish baseline data for all mussel and fish species. These data are the foundation needed to model abundance, recruitment, and persistence of mussel species and fish hosts at different flow regimes.

Deliverables: Initial fish and mussel inventory and establishment of long term monitoring site will be completed during spring/summer of 2012.

Salinity tolerance of the invasive lionfish, *Pterois volitans* (USGS Peninsular Florida LCC funds)

Pamela J. Schofield and Dane H. Huge US Geological Survey, Southeast Ecological Science Center and James A. Morris, Jr., NOAA National Centers for Coastal Ocean Science **Funding:** Total funding for this project is $61,000, with all funding received in FY11. **Project Completion**: October 2011

Overview: Lionfish are currently established along the Atlantic coast of the Southeastern U.S. and throughout the Caribbean and are currently invading the Gulf of Mexico and the coastal reefs of South America; several National Parks are currently in the process of invasion (e.g., Virgin Islands, Biscayne, Everglades, Dry Tortugas). There is great concern that lionfish will impact our national trust lands, should they invade and establish. The potential impacts of lionfish are far reaching, including alteration reef fish communities, drastic reduction in biodiversity, and cascading trophic impacts. Although invasion of coral reef habitats seems imminent, it is

unclear whether lionfish will also be able to inhabit estuarine habitats. It is important to determine the tolerance of lionfish to salinities that are both lower and higher than normal marine waters (35 ppt). If they are tolerant of low salinities, lionfish could spread into nearshore estuarine waters of the Gulf of Mexico and along the Atlantic coast from Florida to North Carolina. Additionally, if they are tolerant to high salinities, they could use regions of Florida Bay that experience seasonal hypersalinity.

Deliverables: Final report – to be delivered no later than October 1, 2011. The final report will serve as the basis for a chapter in the Ph.D. dissertation of Dane Huge and will also be published as a peer-review journal article.

South Atlantic LCC

Develop and extend fish occurrence databases to support the Integrated Aquatic Assessment component of the Southeast Regional Assessment Project (SERAP)

Mary Freeman and Jim Peterson – Total funding $37,000 (FY10)

In cooperation with graduate researchers at the University of Georgia, we have assembled a database of fish species records and associated landscape variables for the upper Apalachicola-Chattahoochee-Flint river basin; we are using these data to build predictive species occurrence relations to support SERAP models of species responses to hydrologic change.

Investigate landscape-level habitat correlates of spawning reaches for the Robust Redhorse, to support management strategies

Mary Freeman and Jim Peterson – Total funding $38,000 (FY10)

In collaboration with partners at the University of Georgia, we have collected additional data on spawning locations of the robust redhorse in the Broad River system (April-May 2011). We have identified a graduate researcher to analyze geographic correlates of spawning sites (work to be completed summer 2011). Predictive modeling useful for identifying spawning habitat requirements in other rivers inhabited by the robust redhorse will be completed in FY12.

Investigate effects of incremental streamflow reduction on fish species distribution using simulation tools developed through the Southeast Regional Assessment Project (SERAP)

Mary Freeman – Total funding $65,500

This work will be initiated early in FY12, after the SERAP simulation tools are finalized. We have identified a graduate research assistant to (beginning in August 2011) simulate effects of flow alteration on projected species distributions, and test sensitivity of the SERAP models to alternative assumptions.

Coastal wetland dynamics and wildlife populations; modeling the effects of sea level rise and landscape change

Glenn Guntenspergen, O'Connell, and Simons– Total funding $134,000 (FY10)

Subtask – data support for sea level rise and bird-habitat modeling. Data was obtained from biologists and added to the database after careful scrutiny of quality (internal edit checks). Data access interfaces were developed.

Modeling and experimental research to guide management of community adaptations in the south Atlantic Coastal Plain in response to climate change and sea level rise

Meyers, Moore, Cooper, and Nibbellink – Total funding $186,622 (FY10)

To date, all state, federal, and NGO-affiliated protected areas that are susceptible to sea-level rise (≤ 1 m elevation) within the South Atlantic LCC have been identified. We have researched status of priority species (candidate, threatened, and endangered) from coastal Virginia south to northern Florida as

possible candidates for experimental research. This research, in the first phase, will emphasize effects of saltwater intrusion on flora and fauna of freshwater sites in Georgia and eventually in other southeastern states. Toward this end, we have met with representatives of National Park Service, US Forest Service, and GA Department of Natural Resources to identify suitable study sites and existing efforts to address climate change and sea level rise. Modeling of climate change and effect of sea level rise on the priority species has begun with assistance of a postdoctoral associate. We also recruited graduate students for the next academic year.

Wetland modeling portion of Coastal wetland dynamics and wildlife populations: modeling the effects of sea level rise and landscape change

Glenn Gutenspergen and O'Connell – Total funding $102,750 (FY11).

Climate change (i.e., global warming) and the resulting rise in sea level have prompted international concern about changes in coastal ecosystems. Loss of these habitats is a threat to many high priority federal trust species identified by several FWS partners (e.g., State Wildlife Action Plans and ACJV Bird Conservation Region plans. This project will address aspects of the U.S. Fish and wildlife Service's (FWS) Strategic Habitat Conservation (SHC) initiative by linking landscape [marsh] response to sea level rise with habitat relationship models for a variety of wildlife species. Anticipated products will allow the Service and its partners to strategically plan future conservation efforts and sustain populations of priority species.

Specifically, we will develop a Bayesian network of response probabilities of the impact of different SLR scenarios on coastal wetland integrity and persistence. The Bayesian network approach can be used to estimate outcome probabilities and quantify uncertainties in regional scale assessments of coastal wetland vulnerability to changes in sea level rise. We will link the outputs from models simulating the response of intertidal wetland complexes to predicted sea level rise to wildlife habitat models.

Radar analysis of fall migration stopover sites in the southeastern U.S.

Dawson –Total funding $43,458 (FY11).

Data from weather surveillance radars in the South Atlantic and Peninsular Florida LCCs will be used to identify important stopover sites for landbirds during the fall migration. We will develop new and improved radar data processing algorithms and software to screen data, identify biological targets, and quantify bird densities; these developments will reduce considerably the time to process radar data and refine the resulting products, providing direct benefits to this project and to future radar ornithology projects.

Quantifying NPS Inventory and Monitoring Conceptual Models Using a Bayesian Network Approach

Mary Freeman (Patuxent) Roxolana Kashuba (NC WSC) - Total funding $57,792 (FY11).

Within the Northeast Coastal and Barrier Network (NCBN) and throughout the National Park Service (NPS), Inventory and Monitoring (I&M) staff have developed conceptual model diagrams to organize their thinking and prioritize which data will be most valuable in understanding complex ecological questions. Within these model diagrams, relationships between nodes such as stressors, change agents, and responses are represented qualitatively and quantitative relationships are unknown or unrepresented. Data are also not currently available or are not being synthesized for all of these diagram nodes. We propose using a Bayesian network approach to quantify two NCBN salt marsh conceptual models to gain a greater understanding about the underlying ecosystems they represent.

Gulf Coastal Plains and Ozarks LCC

Ecological Implications of Climate and Land Use Change within the Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative

Michael Osland. **Total funding**: Total funding for this project is $126,000 (FY10).

Development of Spatially-Explicit Web-Based Decision Support Tools (jointly funded with Gulf Coast Prairie LCC)

Craig Conzelmann. **Total funding**: Total funding for this project is $78,000 (FY10).

Gulf Coast Prairie LCC

Develop Geographic Frameworks for Gulf Coast Prairies Information Management and Delivery System

Steve Hartley. **Total funding**: Total funding for this project is $118,000 (FY11).

Develop Habitat/Landcover Datasets and Maps to Support Predictive Modeling and Landscape Change Analysis

Bill Jones. **Total Funding**: Total funding for this project is $29,000 (FY11).

Development of Spatially-Explicit Web-Based Decision Support Tools (jointly funded with Gulf Coastal Plains and Ozarks LCC)

Craig Conzelmann. **Total funding**: Total funding for this project is $58,000 (FY11).

USFS-USGS Climate Change Project (funded by the National Climate Change and Wildlife Science Center)

Funding: Total funding for this project is $500,000. The project was fully funded in FY10; however, all project work and publications are due at the end of FY12. **Timeline:** This is a two-year project that began in the third quarter of FY 2010 and will continue for two fiscal years, FY11-12. The final report with products will be due in September 2012.

Project Leads: W. Brian Hughes, USGS, Georgia WSC, Atlanta GA and C. Andrew Dolloff, USFS, Southern Research Station, Blacksburg, VA

Project Team:

James T. Peterson	USGS, Oregon CRU, Corvallis, OR
Mary C. Freeman	USGS, Patuxent WRC, Athens, GA
Lauren E. Hay	USGS, NRP, Denver, CO
Jacob H. LaFontaine	USGS, Georgia WSC, Atlanta, GA
Robert B. Jacobson	USGS, Columbia ERC, Columbia, MO
Carolyn M. Elliot	USGS, Columbia ERC, Columbia, MO
Paul L. Angermeier	USGS, Virginia CRU, Blacksburg, VA
Emmanuel A. Frimpong	Virginia Tech, Fish and Wildlife Conservation, Blacksburg, VA
James M. Vose	USFS, Coweeta Hydrologic Laboratory, Otto, NC

Overview: This is a joint-project with the U.S. Forest Service to develop integrated tools that allow natural resource managers to develop and evaluate strategies for minimizing the effect of climate change on aquatic ecosystems and related ecosystem services. There are two concurrent studies, one in the Pacific Northwest addressing the effects of potential temperature and flow fluctuations due to climate change on salmon, trout, and chars and this project, in the Southeast, that is focused on climate change effects on cold-water species and ecosystem services.

Deliverables: The Southeast study will be done in the mountainous portions of the Upper Chattahoochee and Roanoke River Basins and includes the following major products:

- Maps for spatial-overlay analyses of measures of conservation actions and ecosystem services associated with watersheds.
- Comparative models of climate-change effects on stream fishes using occupancy dynamics along thermal gradients in the Upper Chattahoochee and Upper Albemarle-Pamlico Basins.
- Sensitivity analysis to identify additional data needed to have the greatest effect for reducing prediction uncertainty and improve management decision making.
- Reports documenting results of the investigation.